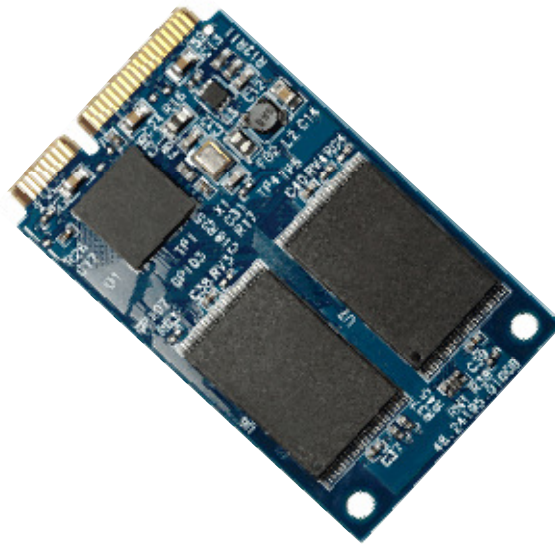fortasa
memory systems

RoHS Compliant

SATA Flash Drive Series

Datasheet for mSATA A1-M - MO-300 Compliant Flash Module
Special Value Added Features

December 1, 2017

Revision 1.2

This Specification Describes the Features and Capabilities of the Standard and Industrial Temperature mSATA Flash Drives

Please Contact Fortasa Memory Systems Sales for any Custom Features Required For Your Specific Application

fortasa
memory systems

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Features:

- **Compliant with Serial SATA Revision 3.1**
  - SATA 1.5 and 2 command set compatible
  - Serial SATA 3 – 6.0 Gbps interface
  - ATA-8 compatible command set
- **Temperature ranges**
  - Operation:
      Standard Temperature: 0°C to 70°C
      Industrial Temperature: -40°C to 85°C
  - Storage: -40°C to 100°C
- **NAND flash type: MLC**
- **Performance**
  - Burst transfer rate: 600 MB/sec
  - Performance
      - Sustained Read: up to 505 MB/sec
      - Sustained Write: up to 360 MB/sec
      - Random read 4K: up to 83,000 IOPS
      - Random write 4K: up to 79,000 IOPS
- **Connector Type**
  - 52-pin mSATA connector
- **Form factor**
  - Mini PCIe (50.8 x 29.85 x 3.60, unit: mm)
  - JEDEC MO-300 compliant
- **Intelligent endurance design**
  - Built-in hardware ECC, enabling up to 40 bit correction per 1Kbyte sector
  - Global wear-leveling scheme together with dynamical block allocation to significantly increase the lifetime of a flash device and optimize the disk performance
  - Flash bad-block management
  - SMART Command
  - *Power Failure Management*
  - *ATA Secure Erase*
  - *Trim Command*
- **Thermal Sensor for Temperature Management**
- **Hardware Pin enabled Data Write Protect**
- **Vendor Specific Military Purge Commands**
- **Vendor Specific Write Protect Command**

- **Capacity**
  8, 16, 32, 64, 128, 256, 512GB
- **Low power consumption (typical)**
  - Supply voltage: 3.3 ± 5%V
  - Active mode: 825 mA
  - Idle mode: 95 mA
- **Endurance in Terabytes Written (TBW)**
  - 8 GB: 14 TBW
  - 16 GB: 27 TBW
  - 32 GB: 61 TBW
  - 64 GB: 129 TBW
  - 128 GB: 277 TBW
  - 256 GB: 587 TBW
  - 512 GB: 1,035 TBW

Table of Contents

1 Product Description

1.1 General Description

Fortasa's mSATA A1-M is a high-performance, SATA interface, solid state drive (SSD) designed to replace a conventional SATA hard disk drive. mSATA supports standard SATA protocol and can be plugged into a standard mini PCIe connector commonly found in rugged laptops, military devices, thin clients, Point of Sale (POS) terminals, telecom, medical instruments, surveillance systems and industrial PCs. Complying with JEDEC MO-300 standard, the mSATA SSD is a widely adopted embedded storage with compact size and exceptional performance.

The mSATA A1-M drive offers capacities of up to 512 gigabytes, providing full support for the SATA 6.0Gbit high-speed interface standard. It can operate at sustained access rates of up to 495 megabytes per second, which is much faster than other solid-state or traditional HDD SATA drives currently available on the market. **Manufactured using Industrial Temperature rated MLC NAND-flash, this SSD can work in highly demanding environment and withstand wide range of operating temperature from -40°C to +85°C.**

mSATA A1-M offers high reliability global data wear-leveling scheme to allow uniform use of all storage blocks, increasing the lifetime of Flash media and optimizing drive performance. The mSATA A1-M also offers Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.) feature monitors the drive accesses and provides the host with vital information about drive condition to schedule maintenance and service times.

1.2 Capacity Specification

Standard capacity specification of the mSATA A1-M Flash Drive product are shown in Table 1-1. The table lists the specific capacity and the default numbers of heads, sectors and cylinders (CHS).

Table 1-1: Capacity specifications

Table 1-1: Capacity specifications

Capacity	Total Bytes	Cylinders	Heads	Sectors	Max LBA
8GB	8,012,390,400	15585	16	63	15,649,200
16GB	16,013,942,784	16383[1]	16	63	31,277,232
32GB	32,017,047,552	16383[1]	16	63	62,533,296
64GB	64,023,257,088	16383[1]	16	63	125,045,424
128GB	128,035,676,160	16383[1]	16	63	250,069,680
256GB	256,060,514,304	16383[1]	16	63	500,118,192
512GB	512,110,190,592	16383[1]	16	63	1,000,215,216

1.   Cylinders, heads or sectors are not applicable for these capacities. Only LBA addressing applies.

Please contact factory for any non-listed SATA Flash Drive capacity or custom CHS requirement.

1.3 Performance Specification

Performance of the mSATA A1-M Flash Drive is listed in Tables 1-2.

Table 1-2: Performance specifications

Capacity / Performance	8GB	16GB	32GB	64GB	128GB	256GB	512GB
Sustained read (MB/s)	120	215	375	390	505	505	495
Sustained write (MB/s)	25	50	100	90	175	345	360
Random Read IOPS (4K)	15,000	26,000	46,000	45,000	77,000	83,000	80,000
Random Write IOPS (4K)	4,000	10,000	24,000	22,000	43,000	79,000	69,000

Note: Performance varies from flash configurations or host system settings.

1.4 Pin Assignments

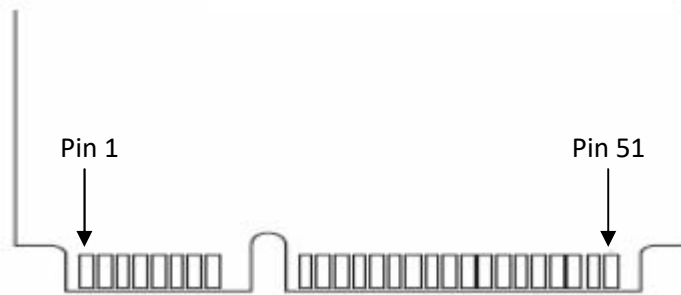Pin assignment of the mSATA A1-M is shown in Figure 1-2 and described in Table 1-3.


Pin 1   Pin 51

Figure 1-2: mSATA A1-M pin assignment

Pin	Assignment	Description	Pin	Assignment	Description
1	N/A	N/A	27	Ground	Return Current Path
2	3.3V	3.3V source	28	N/A	N/A
3	N/A	N/A	29	Ground	Return Current Path
4	Ground	Return Current Path	30	N/A	N/A
5	N/A	N/A	31	Rx-	SATA Differential
6	N/A	N/A	32	N/A	N/A
7	N/A	N/A	33	Rx+	SATA Differential
8	N/A	N/A	34	Ground	Return Current Path
9	Ground	Return Current Path	35	Ground	Return Current Path
10	N/A	N/A	36	Reserved	No Connect
11	N/A	N/A	37	Ground	Return Current Path
12	N/A	N/A	38	Reserved	No Connect
13	N/A	N/A	39	3.3V	3.3V source
14	N/A	N/A	40	Ground	Return Current Path
15	Ground	Return Current Path	41	3.3V	3.3V source
16	N/A	N/A	42	N/A	N/A
17	N/A	N/A	43	Ground	Return Current Path
18	Ground	Return Current Path	44	N/A	N/A
19	N/A	N/A	45**	MP#	Low Active Military Purge
20	N/A	N/A	46	N/A	N/A
21	Ground	Return Current Path	47***	WP#	Low Active Write Protect
22	N/A	N/A	48	N/A	N/A
23	Tx+	SATA Differential	49	DAS	Device Activity Signal
24	3.3V	3.3V source	50	Ground	Return Current Path
25	Tx-	SATA Differential	51	Detection	Zero Ohm Resistor
26	Ground	Return Current Path	52	3.3V	3.3V source

*Notes about Pin51: It is a presence detection pin that shall be connected to GND by a 0 ohm to 220 ohm Resistor on device. Please see the diagram below.

**Notes about Pin45 – Pin 45 is a low active Military Purge - MP# pin. When the host signal on the MP# is low the Flash Controller Executes Pre-Selected Military Purge command. The definition of the MP# pin and interaction between MP# and WP# pin is to be determined.

***Notes about Pin47 – Pin 47 is a WP# pin. When the host signal on the WP# is low the pin is a Write Protect enabled. All destructive commands (Program or Erase) are accepted, yet no change to the data stored on the Flash Drive is made.

Table 1-3: Pin Assignment Description
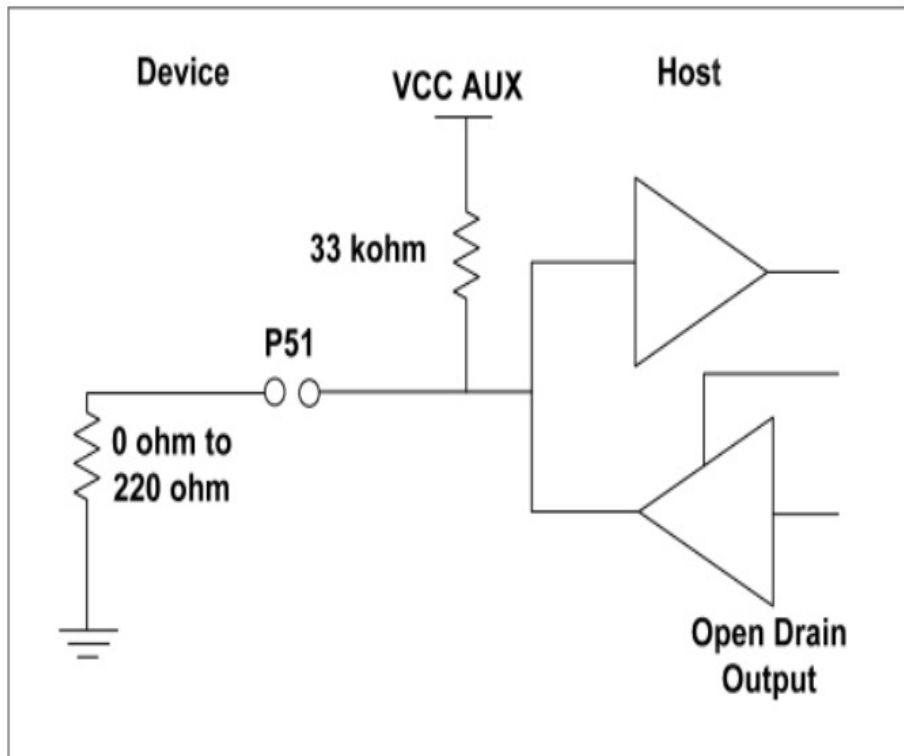
Bi-directional host-side implementation of P51 for compatibility with non-mSATA devices (informative)

1.5 LED Indicator Behavior

The behavior of the mSATA A1-M LED indicators is described in Table 1-4.

Table 1-4: LED Behavior

Location	Status	Description
LED A	Blinking	Accessing Drive
	Static	Write Protect is enabled (only available for models supporting write protection)
LED B	Static	PHY Is Connected

8-256GB   512GB
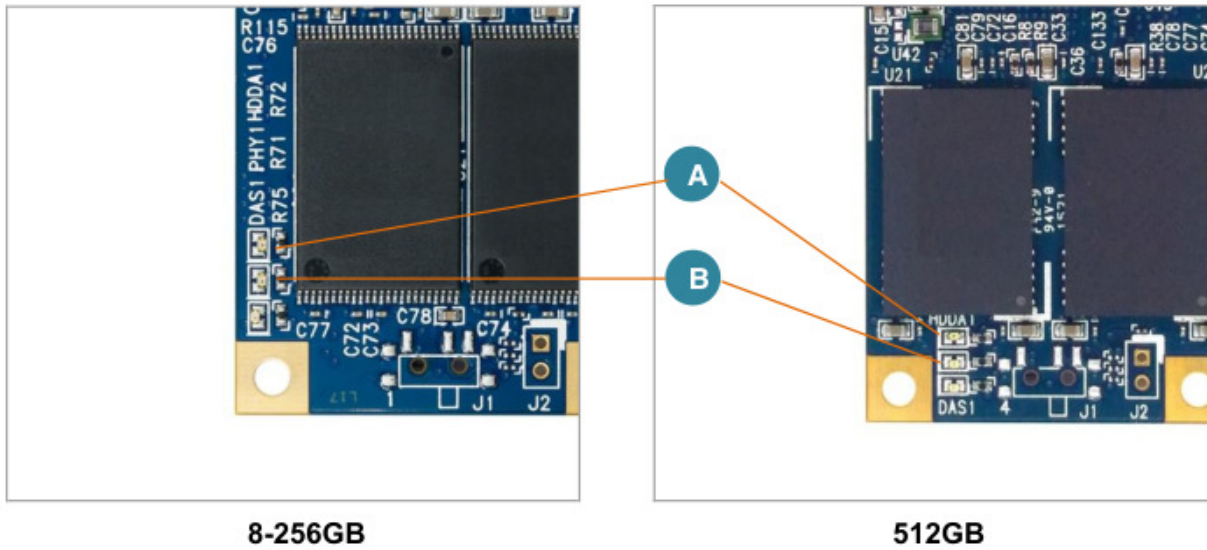
2. Software Interface

2.1 Command Set

Table 2-1 summarizes the mSATA A1-M command set.

Table 2-1: Command set

Command	Code	Command	Code
Check-Power-Mode	E5H	Recalibrate	10H
Execute-Drive-Diagnostic	90H	Security-Freeze-Lock	F5H
Flush-Cache	E7H	Security-Set-Password	F1H
Identify-Drive	ECH	Security-Unlock	F2H
Idle	E3H	Seek	7xH
Idle-Immediate	E1H	Set-Features	EFH
Initialize-Drive-Parameters	91H	SMART	B0H
Read DMA	C8H	Set-Multiple-Mode	C6H
Read DMA EXT	25H	Set-Sleep-Mode	E6H
Read FPDMA Queued	60H	Stand-By	E2H
Read Log DMA EXT	47H	Stand-By-Immediate	E0H
Read Log EXT	2FH	Write DMA	CAH
Read-Multiple	C4H	Write DMA EXT	35H
Read-Sector	20H or 21H	Write Log DMA EXT	57H
Read-Verify-Sectors	40H or 41H	Write FPDMA Queued	61H
Security-Disable-Password	F6H	Write Log EXT	3FH
Security-Erase-Prepare	F3H	Write-Multiple	C5H
Security-Erase-Unit	F4H	Write-Sector	30H or 31H

3. Flash Management

3.1 Error Correction/Detection

The mSATA A1-M implements a hardware BCH-based ECC scheme to achieve up to 40 bits of error in 1K byte page.

3.2 Wear Leveling

All NAND flash devices are limited by a finite number of write cycles. Under a standard file system, frequent file table updates are mandatory. As a painful side effect of OS file overhead, some areas of flash address space wear out faster than others. As these certain sections get a substantially higher write occurrence the whole Flash Drive can wear out very quickly. This uneven wear would significantly reduce the lifetime of the whole device, even if majority of the Flash sectors are far from the write cycle limit. Fortasa's mSATA A1-M Flash Drive products offer advanced data wear leveling which distributes Flash writes evenly across the SATA Flash Drive memory space. By utilizing this advanced wear leveling feature, the lifetime of the media can be significantly extended.

3.3 Power Failure Management

The Low Power Detection on the Flash controller initiates cached data saving before the power supply to the device drops too low for operation. This feature prevents the device from system crash and ensures data integrity during an unexpected brownout. This feature makes sure that there are no catastrophic failures of the SATA Flash Drive due to system power glitches.

3.4 ATA Secure Erase

Accomplished by the Secure Erase (SE) command, which is part of the ANSI standards that control disk drives, "ATA Secure Erase" is built into the disk drive itself and thus far less susceptible to malicious software attacks than external software utilities. Execution of this command amounts to electronic data shredding and causes the SSD to internally completely erase all possible user data. Aside from user data, all data erase counters and other internal controller information stored on the Flash media will be also permanently deleted. The erase process will not stop until it is completed. In case of power failure, the erase process will continue when the power is reapplied to the device.

3.5 S.M.A.R.T. Technology

S.M.A.R.T. is an acronym for Self-Monitoring, Analysis and Reporting Technology, an open standard allowing disk drives to automatically monitor their own health and report potential problems. It protects the user from unscheduled downtime by monitoring and storing critical drive performance and calibration parameters. Ideally, this should allow taking proactive actions to prevent impending drive failure.

Code	SMART Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	Enable/Disable Attribute Autosave
D4h	Execute Off-line Immediate
D5h	Read Log (optional)
D6h	Write Log (optional)
D8h	Enable Operations
D9h	Disable operations
DAh	Return Status

General SMART attribute structure

Byte		Description
0		ID (Hex)
1 – 2		Status flag
3		Value
4		Worst
5*-11		Raw Data

*Byte 5: LSB

SMART attribute ID list

ID (Hex)	Attribute Name
9 (0x09)	Power-on hours
12 (0x0C)	Power cycle count
163 (0xA3)	Max. erase count
164 (0xA4)	Avg. erase count
166 (0xA6)	Total later bad block count
167 (0xA7)	SSD Protect Mode (vendor specific)
168 (0xA8)	SATA PHY Error Count
175 (0xAF)	Bad Cluster Table Count
192 (0xC0)	Unexpected Power Loss Count
194 (0xC2)	Temperature
241 (0xF1)	Total sectors of write

3.6 TRIM Command Support

Over time the performance of SSD degrades as user continually writes and erases data. The ATA-TRIM command "formats" the SSD to optimize the drive performance. A TRIM enabled SSD running an OS with TRIM support will stay closer to its peak performance without much performance variance.

3.7 SATA Power Management

The mSATA A1-M devices support the following SATA power saving modes:
- ACTIVE: PHY ready, full power, Tx & Rx operational
- PARTIAL: Reduces power, resumes in under 10 µs (microseconds)
- SLUMBER: Reduces power, resumes in under 10 ms (milliseconds)
- HIPM: Host-Initiated Power Management
- DIPM: Device-Initiated Power Management
- AUTO-SLUMBER: Automatic transition from partial to slumber.

Note:
1. The behaviors of power management features depend on host/device settings.

3.8 Thermal Sensor

mSATA A1-M contains a Thermal Sensor that measures module temperature. The module temperature can be obtained by polling SMART Command attribute ID 194 (0xC2). When the device temperature reaches a pre-set temperature threshold, the module performance will be reduced to limit the power draw and prevent the module from overheating.

4. Environmental Specifications

4.1 Environments

Environmental specification of the mSATA A1-M Flash Drive series follows the MIL-STD-810G standard as shown in Table 4-1.

Table 4-1: Environmental specifications

Environment		Specification
Temperature	Operation	0°C to 70°C (Standard); -40°C to 85°C (Industrial)
	Storage	-40°C to 100°C
Vibration		Sine wave: 10~2000 Hz, 15G (X, Y, Z) Random: 10-2000 Hz, 7.7Grms (X, Y, Z)
Shock		Operating: 50 G, 11 ms Non-operating: 1500 G, 0.5 ms

4.2 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in the SAFD drive. Based on provided component data, mSATA A1-M Flash Drive is rated at more than 1,000,000 hours.

Notes about the MTBF:
> The MTBF is predicated and calculated based on "Telcordia Technologies Special Report, SR-332, Issue 2" method.

4.3 Certification and Compliance

The mSATA A1-M complies with the following standards:
- CE
- FCC
- RoHS
- MIL-STD-810F

4.4 Endurance

The endurance of a storage device is predicted by a JEDEC approved test methodology. The data, reported in TeraBytes Written, is based on several factors related to device architecture and product usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Please contact Sales to learn more about the TBW analysis and calculations.

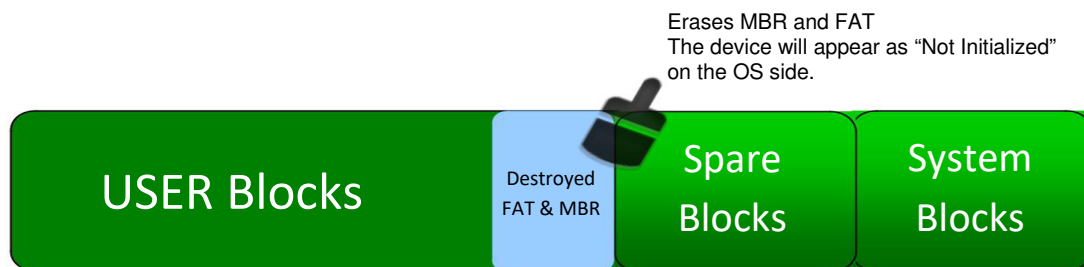| Capacity	TBW
8GB	14
16GB	27
32GB	61
64GB	129
128GB	277
256GB	587
512GB	1,035

Notes:
- The measurement assumes the data written to the SSD for test is under a typical and constant rate.
- The measurement follows the standard metric: 1 TB (Terabyte) = 1000 GB.
- The estimated values are based on JEDEC Enterprise endurance workload comprised of random data with the payload size distribution with sequential write behavior.

5. Special Features (optional)

5.1 Quick Erase

All physical memory blocks of the Flash Memory are categorized into either User Blocks, Spare Blocks or System Blocks. Most of the physical blocks are in the User Blocks category, where the host has read and write access and can store various types of files. Spare Blocks are specifically dedicated for wear leveling and bad block swapping. A small number of blocks are dedicated as System Blocks and are reserved to store system firmware and management data. Typically, the host is unaware of the size and allocation of these blocks so a Logical Block Addressing (LBA) scheme is developed to interface the host OS as logical presentation of physical block addresses. Since it is extremely time-consuming to erase all the physical blocks, a Quick Erase function was developed for cases when there a quick drive erasure is required in a shortest amount of time. Fortasa Quick Erase implementation destroys FAT table and the MBR (Master Boot Record). With the MBR and FAT table erased, the drive appears as uninitialized and mapping links between LBA and physical blocks are erased. In order to access the drive, full re-initialization and FAT table rebuild are necessary.

Erases MBR and FAT
The device will appear as "Not Initialized" on the OS side.

USER Blocks | Destroyed FAT & MBR | Spare Blocks | System Blocks

Command code: 84h
Protocol: Non-data command

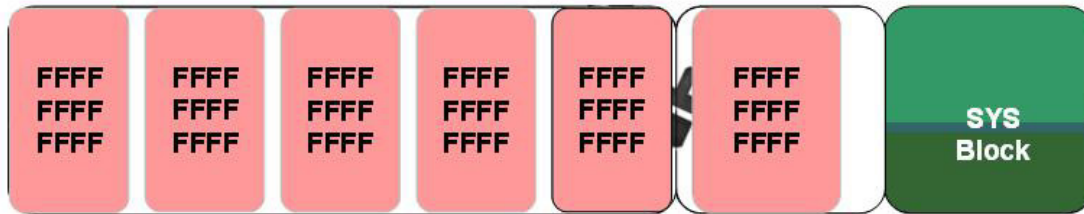| Register	7	6	5	4	3	2	1	0
Features	Subcommand code							
Sector Count	NA							
LBA Low	41h							
LBA Mid	50h							
LBA High	52h							
Device	obs	NA	obs	DEV	NA			
Command	84h							

Subcommand code

Mode	Subcommand code
Quick Erase	0x50

Auto-Resume:
- If a power interruption occurs during Quick Erase procedure, the device restarts the procedure on the next power-up.

5.2 Full Erase

Full Erase sanitizes the LBA and eliminates all the physical blocks in User Block and Free Block. Drive will have to be reinitialized after completion of the erase action. The drive will behave as a raw disk as cells in the drive would display "FF" (or "00").

Erase and overwrite with "FF"pattern

Command code: 84h
Protocol: Non-data command

Register	7	6	5	4	3	2	1	0
Features	Subcommand code							
Sector Count	NA							
LBA Low	41h							
LBA Mid	50h							
LBA High	52h							
Device	obs	NA	obs	DEV	NA			
Command	84h							

Subcommand code

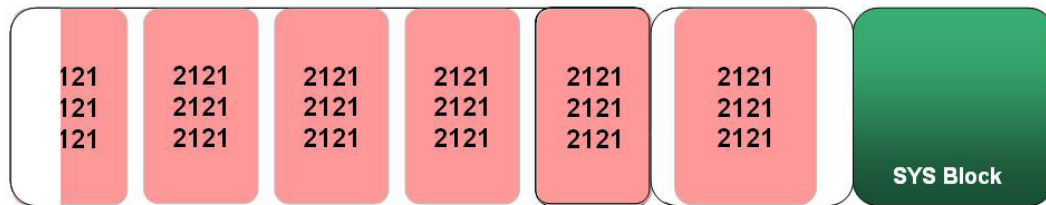| Mode	Subcommand code
Full Erase	0x51

Auto-Resume:
- If a power interruption occurs during Quick Erase procedure, the device restarts the procedure on the next power-up.

5.3 Military Erase

Fortasa Military Erase feature set includes a list of globally certified drive purge methods that comply with the military and industrial standards, such as NSA 9-12. Most of the options sanitize MBR, FAT table as well as user & free blocks by erasing and overwriting every memory block with specifically defined data. These certified erase features are widely utilized, providing conformance in secure data erasure. The standards included in MIL Erase are DoD 5220.22-M, NSA Manual 130-2, USA-AF AFSSI 5020, USA-Army 380-19, USA Navy NAVSO P-5239-26, NISPOMSUP Chap 8, Sect. 8-501, IREC (IRIG) 106, and NSA 9-12 (Gen.2).

EX. NSA 9-12

Command code: 80h
Protocol: Non-data command

Register	7	6	5	4	3	2	1	0
Features	Subcommand							
Sector Count	Parameter 1							
LBA Low	Parameter 2							
LBA Mid	Parameter 3							
LBA High	80h							
Device	obs	NA	obs	DEV	NA			
Command	80h							

Auto-Resume:
- If a power interruption occurs during Purge procedure, the device restarts the procedure on the next power-up.

Subcommand Layout

Bits 6-7 define the parameter count.

Value	Description
00b	No parameter is selected, execute default Purge procedure
01b	1 parameter is selected; defined in bits 4-5
10b	2 parameters are selected; defined in bits 2-3 and 4-5
11b	3 parameters are selected; defined in bits 0-1, 2-3 and 4-5

Bits 0-1, 2-3 and 4-5 define the Executive Mode.
Parameter1 corresponds to the subcommand in bits 4-5.
Parameter2 corresponds to the subcommand in bits 2-3.
Parameter3 corresponds to the subcommand in bits 0-1.

Value	Description
00b	Reserved
01b	Erase
10b	Erase + Write random data
11b	Erase + Write a character

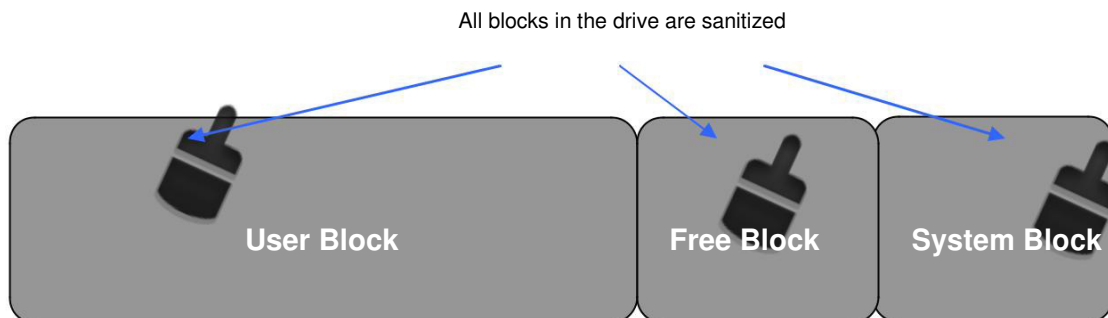The following table lists the subcommand code and the related parameters.

Mode	Subcommand code	Parameter		
		1	2	3
DoD 5220.22-M	0xB4 (10110100b)	char	0x00	0x00
NSA Manual 130-2	0xAC (10101100b)	0x02	char	0x00
USA-AF AFSSI 5020	0x60 (01100000b)	0x01	0x00	0x00
USA-Army 380-19	0xEF (11101111b)	0x01	char	~char
USA Navy NAVSO P-5239-26	0xA4 (10100100b)	0x01	0x00	0x00
NISPOMSUP Chap 8, Sect. 8-501	0xFE (11111110b)	char	~char	0x01
IREC (IRIG) 106	0xFD (11111101b)	0x55	0xA1	0x00
NSA 9-12 (Gen2)	0x70 (01110000b)	0x21	0x00	0x00

The following table lists purge procedure details and respective proposed standard.

Organization	Function description
DoD 5220.22-M	• Erase the blocks + overwrite with single character • Erase the blocks
NSA Manual 130-2	• Erase the blocks + overwrite with random data (1st) • Erase the blocks + overwrite with random data (2nd) • Erase the blocks + overwrite with single character
USA-AF AFSSI 5020	• Erase the blocks + overwrite with random data
USA-Army 380-19	• Erase the blocks + overwrite with random data • Erase the blocks + overwrite with single character • Erase the blocks + overwrite with complement of the character
USA Navy NAVSO P-5239-26	• Erase the blocks + overwrite with random data • Erase the blocks
NISPOMSUP Chap 8, Sect. 8-501	• Overwrite with single character • Overwrite with complement of the character • Overwrite with random data
IREC (IRIG) 106	• Erase the blocks + overwrite with 0x55 • Erase the blocks + overwrite with 0xA1 • Erase the blocks
NSA 9-12 (Gen2)	• Erase the blocks + overwrite with 0x21

5.3 Self Destruction (Suicide) Erase

Self Destruction Erase is the ultimate disk termination solution. The purpose of this feature is not only for destroying the FAT, MBR, User and Spare Blocks, but more importantly, Flash Controller firmware, mapping/allocation table and other maintenance mechanisms in the System Block in an SSD. With the System Block totally terminated, the SSD can no longer function as storage media and will not be recognized by any host.

All blocks in the drive are sanitized

User Block   **Free Block**   **System Block**

Command code: 84h
Protocol: Non-data command

Register	7	6	5	4	3	2	1	0
Features	Subcommand							
Sector Count	NA							
LBA Low	41h							
LBA Mid	50h							
LBA High	52h							
Device	obs	NA	obs	DEV	NA			
Command	84h							

Subcommand code

Mode	Subcommand code
Self Destruction	0x48

5.4 Write Protection Command

Write Protection Command will make the Flash Drive completely Write Protected. Once the command is properly issued, the drive will enter into a Virtual Write mode that allows write commands to be accepted by the flash controller and data change temporarily stored. The OS will function normally without any Error messages, but since the whole process is virtual, no physical data will be actually written into the flash. When the host system is reset or rebooted, all the temporarily stored data will be lost and nowhere to be found in the system.

Since the Virtual Write mode runs at device level, it requires no software or driver installation and is independent from the host OS.

Command code: 84h
Protocol: PIO-out Command

Register	7	6	5	4	3	2	1	0
Features	Subcommand							
Sector Count	01h							
LBA Low	41h							
LBA Mid	50h							
LBA High	52h							
Device	obs	NA	obs	DEV	NA			
Command	FBh							

Subcommand code

Subcommand	Definition
01h	De-Activate Configuration
03h	Activate Configuration
05h	Change Password

Behaviors
- Password change is required to activate Write Protect for the first-time use.
- When the protection is activated, all write related commands will be turned into Virtual Write state.
- Virtual Write can be enabled/disabled by the software command under operating system.
- When enabled, the operating system recognizes the data transferred by Virtual Write as temporarily stored. However, it is not written to the flash.
- Once the device is powered off and back on, all the temporarily stored data will be permanently removed from the drive.
- If Write Protect is disabled, the host can perform write commands normally.
- If Write Protect has been enabled previously via hardware GPIO (pin 47) trigger, the host cannot enable/disable the function by software command as the command will be aborted.
- When Write Protect is enabled, other commands issued by the host will be aborted, except Device Protect. When both Write Protect and Device Protect are enabled, the host has to disable the two functions individually.
- The methods of activation / de-activation should be identical. For example, when Write Protect activation is done by the host command, the de-activation should be also done by the host command.

Error Output

The error bit in the Status Register will be set and Error Register will have the following error code:

0x40: Password Reset

- The default password is set to all 0s. A password change is required in order to activate the Write Protect. If not, an error is returned.

0x41: Password Mismatch

- To activate / de-activate the Write Protect, password verification will be performed. An error output is returned if the current password and input one mismatches.

0x44: Invalid Activation

- To activate the protection, the state of the drive should be in de-active state. If activation is requested while the drive is in active state, an error output is returned.

0x45: Invalid De-activation

- To de-activate the protection, the state of the drive should be in active state. If de-activation is requested while the drive is not in active state, an error output is returned.

0x50: Configuration Conflict

- To activate the protection, it requires a preliminary check if hardware Write Protect is enabled. If it has been enabled by hardware trigger, an error output is returned.

De-activate Configuration

The command will be aborted if Write Protect is not configured as to be activated.

Password Data Format

The command request a transfer of single sector of data from the host including information specified per table below.

Word	Content
0	0x00AC
1-16	Default / Current Password (32 bytes)
17-255	Reserved

Activate Configuration

The command will be aborted if Write Protect is configured as to be activated.

Password mismatch will make the command be aborted as invalid command.

Password Data Format

The command request a transfer of single sector of data from the host including information specified as the table below.

Word	Content
0	0x00AC
1-16	Default / Current Password (32 bytes)
17-255	Reserved

Change Password
Password mismatch will make the command be aborted as invalid command.

Password Data Format
The command requests a transfer of single sector of data from the host including information specified as the table below.

Word	Content
0	0x00AC
1-16	Default / Current Password (32 bytes)
17-32	New Password
33-255	Reserved

6. Electrical Specification

6.1 Operating Voltage

Caution: **Absolute Maximum Stress Ratings –** Applied conditions greater than those listed under "Absolute Maximum Stress Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.

Table 6-1: Operating range

Range	Ambient Temperature	Power
Standard	0°C to +70°C	3.3V ±5% (3.135 - 3.465 V)
Industrial	-40°C to +85°C	

6.2 Power Consumption

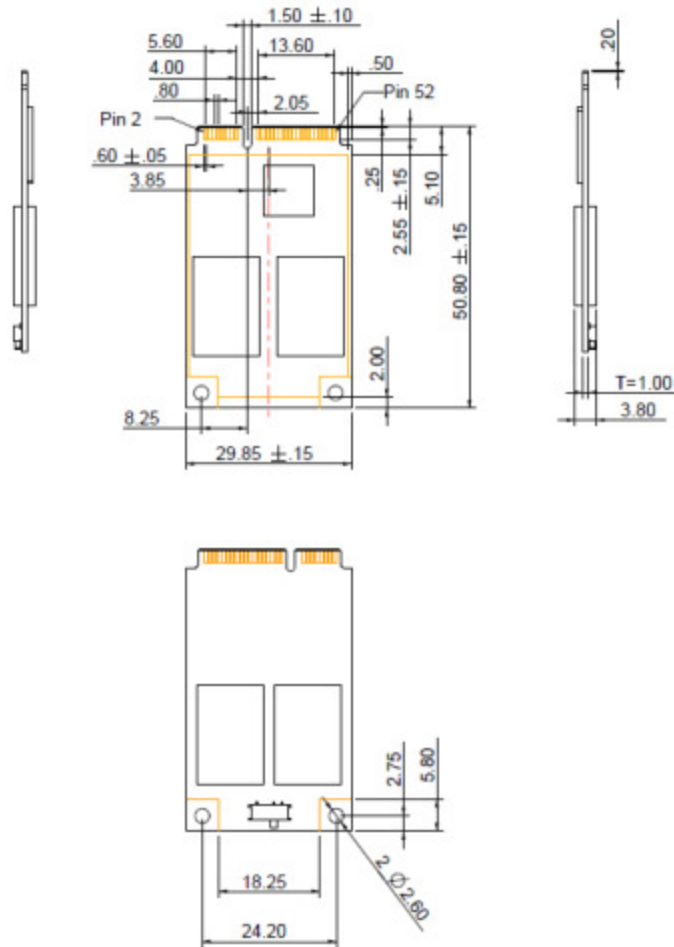Tables 5-2 lists the mSATA A1-M power consumption.

Table 6-2 mSATA A1-M power consumption (typical)

Performance / Capacity	8GB	16GB	32GB	64GB	128GB	256GB	512GB
Active Mode (mA)	235	270	320	335	460	710	825
Idle Mode (mA)	90	90	90	95	95	95	80

Note: Results may differ from various flash configurations or host system setting.
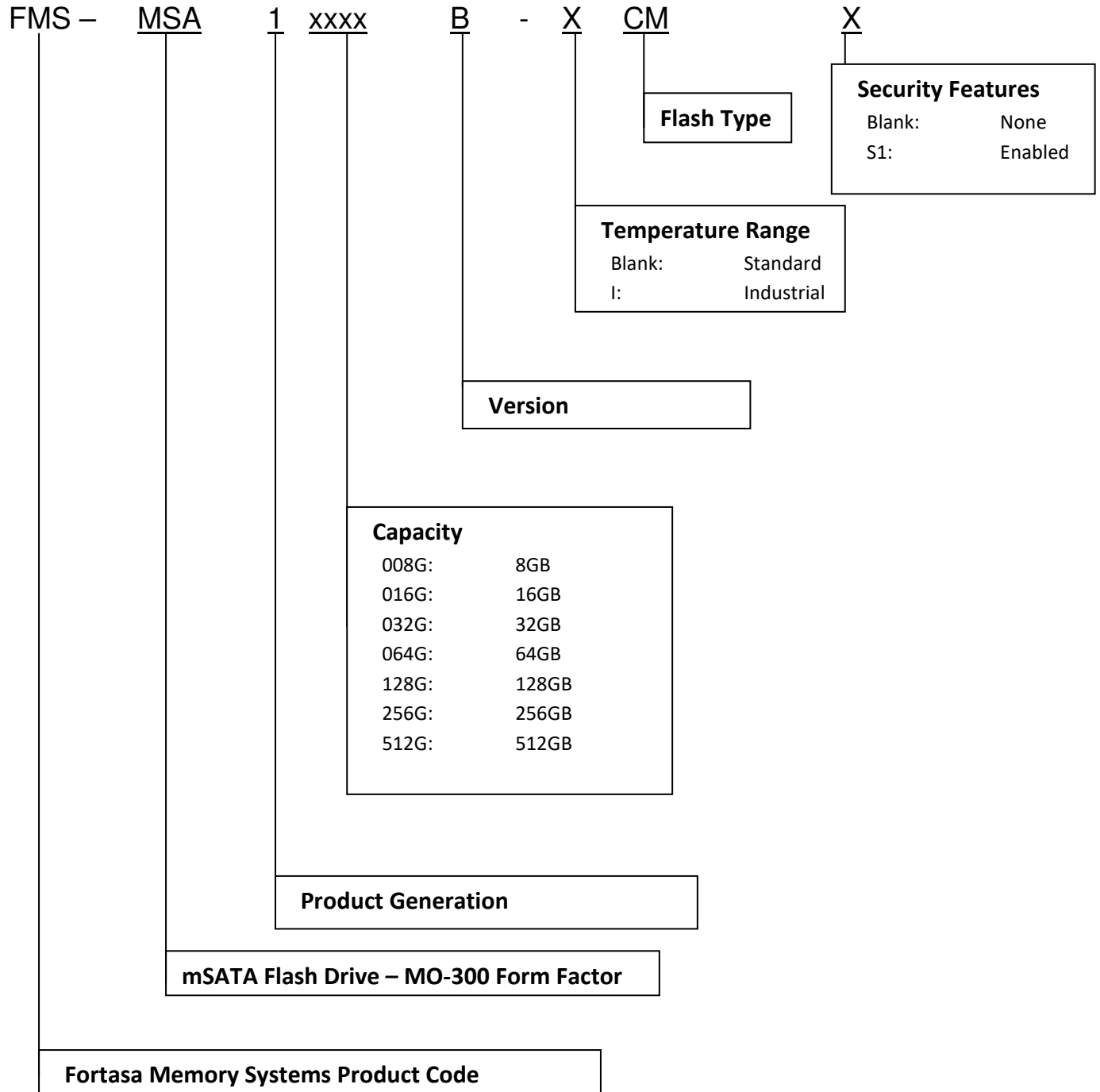
7. Physical Characteristics

7.1 Dimensions

Units: mm

8. Product Ordering Information

8.1 Product Code Designations

FMS –   MSA   1   xxxx   B   -   X   CM   X

Flash Type

Security Features
Blank: None
S1:   Enabled

Temperature Range
Blank: Standard
I: Industrial

Version

Capacity

008G:	8GB
016G:	16GB
032G:	32GB
064G:	64GB
128G:	128GB
256G:	256GB
512G:	512GB

Product Generation

mSATA Flash Drive – MO-300 Form Factor

Fortasa Memory Systems Product Code

8.2 Valid Combinations

mSATA A1-M
Security Features - Disabled

Capacity	Standard Temperature	Industrial Temperature
8GB	FMS-MSA1008GB-CM	FMS-MSA1008GB-ICM
16GB	FMS-MSA1016GB-CM	FMS-MSA1016GB-ICM
32GB	FMS-MSA1032GB-CM	FMS-MSA1032GB-ICM
64GB	FMS-MSA1064GB-CM	FMS-MSA1064GB-ICM
128GB	FMS-MSA1128GB-CM	FMS-MSA1128GB-ICM
256GB	FMS-MSA1256GB-CM	FMS-MSA1256GB-ICM
512GB	FMS-MSA1512GB-CM	FMS-MSA1512GB-ICM

Security Features - Enabled

Capacity	Standard Temperature	Industrial Temperature
8GB	FMS-MSA1008GB-CMS1	FMS-MSA1008GB-ICMS1
16GB	FMS-MSA1016GB-CMS1	FMS-MSA1016GB-ICMS1
32GB	FMS-MSA1032GB-CMS1	FMS-MSA1032GB-ICMS1
64GB	FMS-MSA1064GB-CMS1	FMS-MSA1064GB-ICMS1
128GB	FMS-MSA1128GB-CMS1	FMS-MSA1128GB-ICMS1
256GB	FMS-MSA1256GB-CMS1	FMS-MSA1256GB-ICMS1
512GB	FMS-MSA1512GB-CMS1	FMS-MSA1512GB-ICMS1

Note: Valid combinations are those products in mass production or will be in mass production. Consult your Fortasa sales representative to confirm availability of valid combinations and to determine availability of new product combinations

9. Revision History

Revision	Date	Description	Comments
1.0	6/13/2016	Initial Release	
1.1	11/30/2016	Added LED Indicator Behavior Section	
1.2	12/1/2017	Added pin 47 (WP#) definition Added Write Protection Command – Section 5.4 Changed Valid Combinations – Section 8.2	